appropriate distance for the sources to be placed from the skin surface. The trajectories which the sources would take were then drawn, with uniform separation, on this surface. The mould was completed by extending the surface further and then subtracting the trajectories. The complete STL file was then sent to the printer for fabrication by the Stratasys Objet500 Connex1 printer, and printed using a Rubber-like material (TangoPlus).

Results: Catheters produced by Elekta for connection to the Flexitron HDR treatment unit, were successfully inserted into the 3D printed mould without damage and minimal air gaps. The patient attended clinic and had the mould positioned. The mould fitted extremely well and was comfortable for the patient. The fit far exceeded the conformity of the conventional plastic shell mould which was also made for the patient, in particular between the patient's fingers. A CT scan of the patient's hand with the 3D mould attached was acquired. The CT image set was imported into the Oncentra Brachy TPS (treatment planning system) manufactured by Elekta and the catheters were reconstructed. A target volume was delineated by the Consultant Clinical Oncologist and a treatment plan created to deliver the prescribed dose to the target volume. However, due to the proximity of the surrounding healthy fingers, it was determined that they would receive an unacceptably high dose. As the patient was unable to separate his fingers more it meant, unfortunately it wasn't possible to treat him using HDR brachytherapy. A dummy run of the planned treatment was performed proving in principle the procedure was viable.

Conclusions: A 3D printed mould could be created that fitted the patient's anatomy extremely well. Channels could be created within the 3D printed mould that allowed insertion of catheters manufactured by Elekta for the radioactive source to travel along safely and accurately. We have since used the patient CT image set to create alternative positions for the catheters within a mould in order to improve the overall treatment plan by reducing the dose to the other fingers and keeping the target dose aim. For future patients an additional CT scan of the patient will be performed prior to the mould manufacturer to calculate the optimal position of the catheters within the TPS. The desired mould will then be created in the 3-Matic design software and printed. A second CT scan will be performed to verify the fit of the mould. As an initial study this was very successful as the 3D printed mould was suitable for clinical use and a better fit and easier to plan than previous manually created patient moulds.

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Visualization of the 3D Dosimetry for a Leipzig Brachytherapy Applicator Using 3D Slicer

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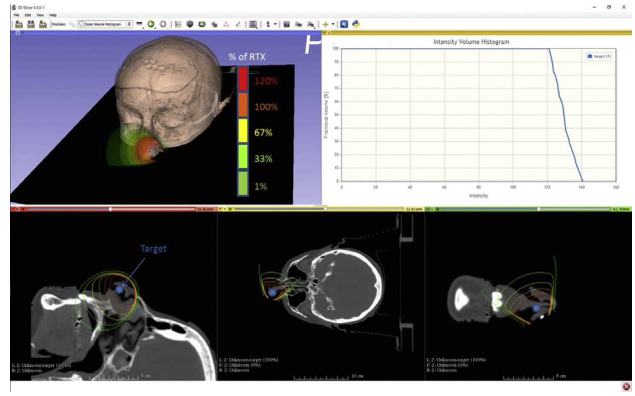
Purpose: Surface brachytherapy (BT) is an alternative to electron beam therapy (EBRT) for the treatment of superficial skin lesions. Elekta's (Elekta AB, Stockholm, Sweden) high dose-rate (HDR) BT solution utilizes conical surface applicators (Leipzig) connected to an 192-Ir remote afterloader with treatment planning accomplished using nomograms derived from Monte Carlo simulations. Since this approach provides no 3D dosimetry, prospective and retrospective analysis of the treatment volume and normal tissue coverage is not possible. To facilitate such analysis, we have developed a work flow for 3D Slicer [1] and SlicerRT [2] plug-in to import, view and calculate dose-volume histograms (DVH) for this BT application.

Method: A HDR surface BT treatment plan for a superficial nose lesion was selected from our clinical database for this proof-of-principle study. A 3D CT dataset of the patient, with a fiducial marker placed on the area of palpable disease, was acquired at the beginning of the BT course to ascertain the required depth of treatment, 3mm. Using this information, a clinical treatment volume (CTV) was created to roughly approximate



desired clinical coverage. Matlab (The MathWorks, Inc., Natick, MA) was used to create a 3D dose-rate distribution using the Leipzig "H2" applicator dose specifications presented by Perez-Calatayud et al. [1]. This distribution was scaled according to the delivered source dose rate and treatment prescription, 0.32 cGy h-1 U-1 and 400 cGy x 10, respectively. The dose distribution was imported into 3D Slicer and registered to the image set manually, using the known geometry of the applicator and radio-opaque fiducial marker as landmarks. Isodose visualization and DVH were calculated for the CTV using SlicerRT.

Results: Figure 1 shows the relative 3D isodose distribution and resultant CTV DVH using this method. For this application, 100% of the hypothetical CTV receives prescription dose. The homogenous 3D dose distribution is able to be visualized on synthetic 2D axial, coronal and sagittal planes.

Conclusion: This proof-of-principle investigation demonstrated the ability to visualize 3D dose distributions and calculate resultant DVH for segmented structures using a widely-available, non-commercial software package. With further development, this method has potential for providing more accurate spatial dose estimates for patient treatments and advance superficial HDR BT treatment planning to align with the current, clinically-utilized 3D treatment planning paradigms used for gynecological, prostate and breast HDR BT. Furthermore, this technique may serve as a platform for the development and verification of model-based, inhomogenous dose calculation algorithms for superficial BT applications.

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Cosmesis Outcomes in Patients with Non Melanoma Skin Cancer (NMSC) Treated with Hdr Brachytherapy

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